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Aerosol pollution in the arid and semi-arid regions of southern Russia

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We present the systematized data results from field measurements of submicron aerosol. These measurements were carried out in the steppe regions of Rostov region and in semi-desert areas of Kalmykia Republic (the Caspian lowland) in the summer period of years 2007-2013.

These data include the diurnal variation of the counting and mass aerosol concentration in the range of 0.1-15 microns, the diurnal variation of the counting and mass concentrations of the various fractions of submicron aerosol, the elemental composition of aerosol and soil samples, meteorological parameters of the atmosphere, soil temperature and radiation balance.

Fine sand fraction (86.6%) is predominant in the soil. It is significantly higher than the percentage of silt fractions, medium and coarse sand. The chemical composition of sand is aluminum-silicon one. Elemental and mineralogical analysis of soil and aerosol particles confirmed the identity of the chemical composition of the soil and the fine fraction of the aerosol, respectively.

Obtained data show the presence, in hot and dry weather, of convective lifting and outflow of fine aerosol in the daytime over dry sandy areas and dry loamy soils, in these areas.

Studies have shown that the removal of the fine aerosol increases proportionally to the temperature lapse rate in the surface air layer and decreases with increased wind speed. The coarser fraction of aerosol prevails in the airflow for wind speed of 5 m/s and more.

Relationship between the aerosol emission and the stability of the atmospheric boundary layer (Monin-Obukhov length-scale) is considered.

Aerosol mass concentration at different periods of observations (2007-2013) was from a few dozen to several hundred mg/m^3. Calculations of the average annual value of the convective flow of the aerosol into the atmosphere from sand areas in Kalmykia are presented.

Distribution of lifted aerosol particles depends on the weather conditions (wind speed, relative humidity air and soil, surface temperature, radiation balance).

The wind speed influences formation of the spectrum of coming off aerosol particles in the range of 1-5 μm and jointly with the surface temperature in the range of 0,01-0,1 μm, correspondingly. In the range 2-15 μm the slope of the spectrum is close to -3, which is consistent to the recently proposed concept of fragmentation (J. Kox). For submicron particles (< 1 μm) the spectral slope is close to -5$\div$-6.

It is planned to use the obtained data for the parameterization of aerosol lifting process aiming at inclusion of non-saltation convective dust source mechanism into the meso-scale WRF-Chem model.